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ABSTRACT

The status of pre-college science education in Japan is reviewed and analyzed in this paper from four different perspectives having to do with the impact of the national syllabus and with social problems, teacher problems, and the changes occurring with students. Japan's national syllabus is explained and elements related to its implementation, revision, requirements, and textbook usage are discussed. The role of parents as a strong pressure group in pre-college education is examined and the demands and concerns associated with entrance to the university are explored. Teacher training programs and systems are outlined and assessed in terms of preparation for instruction of the sciences. The factors affecting students and their attitudes in learning are also identified. Recommendations are offered, and it is suggested that emphasis be placed on educational diversification and on changes in the system of teacher education that will enhance teachers' ability to develop logical thinking and reasoning skills in their students. (ML)

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Overview of Pre-College Science Education in Japan

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Pre-college education in Japan is one of the social issues today. Many different opinions have been expressed and our government is trying to summarize those opinions for innovation. Since the feature of the pre-college education in Japan is uniformity, it gives us various problems intrinsic to its nature, although it has some good points as well. I wish to analyze the situation from four different view points, although all these points are closely correlated. They are national syllabus problems, social problems, teacher problems, and students themselves.

Since Japan is a poor country as far as natural resources concern, we had put emphasis on science education, hoping that science should lead to prosperity of the country through development in industry. This view point is still very strong in some of our people. However, there is also a strong feeling among our nation that development of science does not always mean good. This kind of thought has grown up especially from the days when kogai or pollution probles have emerged in 1960's. When this latter thought is combined with our national tradition, it gives science education a hard situation.

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We may have to go back to Yedo era when systematic education was first introduced to public in Japan. At that time, the main source of culture was Chinese classics. In schools, emphasis was placed on reading and writing. There is a saying which well reflects the belief of those days: if you read a sentence hundred times, the meaning will become self-evident. Arithmetic was also important because the schools were open to children of merchants.

Science and technology were also important but they were taught to successors as an art. By art, I mean that neither books were written to teach successors nor was there any systematic way of training. Rather, the successors were encouraged to see and imitate what their teachers did. It was important for them to learn how to do, for example, sword making by practise. Science and technology have never been thought basic in Japan.

This kind of traditions still prevails in our country at least in some parts of people and is harmful when we discuss improvement of science educ ion. When people talk about basic education, it means reading, writing, and calculationg, although many of science people think that natural science is very basic at the present time: according to the latter, science literacy is one of the musts in modern social life and proper attitude toward nature is highly desirable for the people who constitute the world of next generation.

In spite of this unfavorable background to science, many realize that development of science and technology in Japan has

been the basis of the prosperity of the country in rather a short period of time after the World War II. This is especially strong in people in industry. They need good successors. Academia also seek their successors through education. In order to win or at least not to loose competitions in science and technology in the world, it is essential to get enough number of competent scientists in these fields. And the advanced science and technology require more and more advanced knowledge to become successors. Thus these people insist that science education in schools should be up-graded to meet the needs of industry and academia. From the side of industry, there is another aspect of science education which should not be overlooked. That is, science literacy is needed for consumers of these days because they have to use sophisticated gadgets for their daily lives. To widen the consumer market, science literacy is an important factor for industries.

A national syllabus, which is called the Course of Study, is a symbol of the uniformity of our education. Our Ministry of Education, Science and Culture sets it after consultation with various groups and individuals. Our school education must conform with this syllabus. The Ministry convenes groups of specialists as teams for revision of the national syllabus. By specialists, teachers from among schools and professors from universities are involved. The revision is not regular but often with intervals of about 10 years.

The national syllabus was introduced in Meiji era when compul-

sory education was enacted. When we opened our country to the foreign at the time of Meiji Restoration, people were shocked by the existing gap in science between Japan and western countries. Rich country and strong military became passwords of Japan. To realize those aims, education was important but they could not wait long. The way they chose was that science was taught like chinese classics. Theories and facts were taught at schools to memorize them and application of these to new fields was encouraged. This type of attitudes of Meiji people, I believe, was the origin for what we are acused today: Japanese are good at imitaitng but not good at inventing very original things. In other words, only one of the aspects of science, that is deduction, was taken important in our science education and another important aspect, induction, has been overlooked. I am afraid that this point is the origin of lacking logical thinking and reasoning in Japanese. To cope with this situation, Japanese may have to work hard to modify the tradition of our culture.

The Ministry pays lots of efforts to absorb opinions of various people when they modify the system of education or items of the syllabus. They survey opinions of teachers and even select trial schools when they wish to introduce new styles or new items of education. The problem is that only able teachers express their opinions. One of very interesting problems in this respect may be cited here. Once there were two items in the primary school syllabus which were very unpopular, drosophila and hatching of eggs. The former was felt unsanitary and the latter affected

children, especially girls, to make them unable to eat eggs in worst cases. Therefore, the general opinion was to remove these items from the syllabus to be revised in the next time. However, a survey of school teachers surprisingly showed that more than half of the teachers said that these should be retained in the next syllabus. The reason was interesting. Since these items were hard to teach, teachers tried hard to improve the situation. And they were then confident that they could continue them. We cannot call them conservative but they actually are.

The problem also exists in the team of specialists who are members of the committee for the revision of the syllabus. The members of school teachers are selected from among able teachers. University professors may often demand to include items in the syllabus from purely scientific view points, neglecting the reality at schools. Good examples are those syllabuses set in 1960's, when the influene of innovation in science education in USA was very strong. The majority of school teachers may not be ready to accept the innovation but able teachers may agree with the proposition because they are confident in implementing them and they think those are important.

Unfortunately this kind of demands occurs not only from hte science teachers but from all subjets in schools. English teachers claim that English teaching should be given more time because internationalization is apparent. Mathematics teachers insist that new aspects which are essential from the view point of mathematics should be included in school teaching rather than

mere calculation only because the logics involved is important in daily life. Poor are the students. They are the persons who have to learn those which are thought to be important by specialists.

As a result, students are forced to study tremendous amount of items in a limited amount of time. It will be necessary to memorize what is written in text books rather than to understand it. The times alloted for science are as follows:1st and 2nd grades 2 hours, 3rd through 8th grades 3 hours, and 9th grade 4 hours a week. Our compulsory education ends at the end of the 9th grade. Therefore, selection can be made from among science courses in upper high schools. Science I is required for everybody of which teaching is usually in the 10th grade and the unit is 4, that means 4 hours a week for one year. Physics, chemistry, biology and earth sciences comprize 4 elective courses. According to statistics, chemistry is taken by about 75% students with the close second of biology. Physics and earth sciences are suffering from unpopularity, each being selected by less than half of the students. They comprise all 4 unit courses. Incidentally, in primary schools, science is one course but, in lower high schools, science is divided into two courses, one being a combination of physics and chemistry areas and another being a combination of biology and earth sciences areas.

Text books are editied by private publishing companies with editorial groups of school teachers and university professors. The text books have to pass inspection of the Ministry of Education

to be used in class rooms. Selection of the text books are made by local authorities in compulsory schools after consultation with specialists or school teachers and by school teachers in upper high schools. This selection poses another problem, especially for compulsory schools. Because there is a strong tendency that teachers teach text books rather than they teach with the aid of text books, that is forcing memorization of the content of the text books is popular, simpler text books are better appreciated than thick ones. Even newspapers say that the thinner the better are the text books. Therefore, if text books are edited to show or explain how to recognize or how to understand, they lose popularity. As a result, those are not commercially healthy. Thus the Japanese text books are strongly affected by the view points of society as well as school teachers. In addition to the above points, there is one point which cannot be forgotten when we discuss the problem of text books. That is, text books are free of charge for school children in compulsory schools. They are paid by the federal government. Our Ministry of Finance of course likes cheaper text books and sets maximum price for a copy. Under these circumstances, it is quite natural for a publishing company to seek text books as thin as possible.

Parents comprise a very strong pressure group in pre-college education in Japan. Before describing the situation, it may be better to analyze why Japanese parents think in that way. On one hand, after the World War II, it has become overwhelming for a Japanese family to have two children. Because of the small

number of children, the children are more precious things for parents than before. They dislike that their children are given any kind of disadvantageous situation. On the other, because the parents who did not receive high education before the war believe that they are not given good enough chances to be promoted or to be hired by a good company, their children should not miss the chance. In order to not miss the chances their children should receive good education. This is why about 94% youngsters of the same age group attend upper high schools and 36% of the people enroll at colleges. Even handicapped children wish to attend the same school as the normal.

This large population of the students caused variety of levels of understanding especially at upper high schools. Not all the items shown in the national syllabus are understood by everybody. Yet what are described in the syllabus are expected to be taught at schools. If teachers leave anything which is written in a text book behind, parents will call teachers to tell that their children should be given a chance to study the item. Therefore, teachers are forced to teach everything in text books although their desire may be to let students understand what is written there and to foster able persons in the application of the item. This is irritating to teachers because they think, if they were given more time, it would have been much more understandable to children.

To make the things worse, the competition to get enrolled in good universities is very keen in our country. Differing

from the situation in the United States, the number of good universities is limited in Japan. Big industries wish to recruit students from prestigious universities. Then the parents in Japan wish to send their children to good universities. The children have to prepare very well to win the competition. This tendency is more and more apparent. Finally it is said that even children in kindergartens are competing to get good seats in primary schools and then in higher schools. It is very common then that parents send their children to "after-school" school which is called juku in our country for better preparations. As a result, parents have begun to think that the preparation is a burden for their children. They begin to say that the tension for the preparation for the entrance examinations of good universities should be relaxed. Then pre-college education has become a social issue in Japan.

Entrance examinations to colleges had been accused to be asking too difficult questions to students. To respond to this pressure, national and public universties extablished a system of Joint Achievement Test for college entrance in 1979. Since, if a subject is dropped from entrance examinations of colleges, it will not be seriously studied in high schools and thus disturbs education there, colleges with consultation with high schools asked to take five subjects in the Joint Achievent Test. They are Japanese language, English, mathematics, science, and social science. This demand matched the fact that the broad background is respected in our country rather than a specialist. However,

today mass communication people with parents are giving pressure to universities, saying that the examinations of five subjects are a too heavy burden to high school students. Since private universities do not demand five subjects in entrance, private universities are getting popularities in these days. Because of those pressures, national universities decided to lessen the number of subjects to be examined at the Joint Achievement Test starting from 1987. Students have to take only one area of science instead of two today in the expected Joint Achievement Test. It seems, however, that this level of reduction will not be sufficient for the pressure group. I am afraid that the pressure will build up again in the near future.

The training of teachers cannot be overlooked when we discuss pre-college education in Japan. There are two points which can be mentioned here. One is the fact that even a junior college graduate can be a primary school teacher if she/he takes necessary units in that institution. Although it is becoming increasingly difficult for a junior college graduate to take a teaching job because of the decrease in population of the primary school age groups, this fact means that there are many primary school teachers who are not well trained in science. They do not like to teach science especially chemistry. All the chemicals are something evil for them. This is not only bad for science education itself but also affects the way of thinking of children. We are very much concerned about this situation. Colleges for teacher training are in a little better situation than the junior colleges, yet

they are in the region of "a little better." According to the statistics, there are only about 20% students who major science and teach science in primary schools. This means that a majority of primary school teachers has not received sufficient training in science, especially in laboraotry works. Today, in many of schools, there are science specialists who teach 5th and 6th grade science. This may solve a part of the problems yet it is not a complete solution, because primary school children may be affected strongly by the personality of teachers. If teachers do not like science, their attitude will be influential to children even though the teachers may teach other subjects.

Students in normal four year colleges can obtain qualification as teachers in secondary schools, if they take necessary courses. This system causes another problem. Students who have not received sufficient training in teaching but training in science can take the teaching job. As a consequence, the teachers may teach students from the view points as scientists rather than teachers. It often leads to teaching of things which are not understandable to students.

To cope with these problems, we have launched a few systems. The first was sience centers which were instituted in every prefecture. This mechanism is working well to some extent because usually the local authority is the employer of teachers and the science centers have the power of asking school masters to send their teachers for the refresher courses. However, it is not practical to have extensive courses in these centers, because of

various problems including substitution teachers. The centers rather try to attract teachers to short courses because they think they are more effective. The second is the establishment of universities of teacher education. They retrain teachers who have had some experiences of teaching to lead to masters degree. It is aimed here to raise leaders in schools. From the stand point of science, the problem here may be that science is only a branch of all fields. Seeking emphasis on science education is almost impossible in these institutions. The history of these institutions is very short. We may have to wait some time to evaluate the role of them.

Students of today have changed to a great extent from those some thirty years ago. This is because society has changed. The typical change is caused by the electronics and handling the way of information. The technology based upon electronics has changed our lives from what we call "we have to do by ourselves" to what we call "push a button then everything is done by a machine." People have become not to pay much attention in pushing buttons, although it was necessary some time ago to judge before doing something. In addition to these situations, we are suffering from the flood of information. Information is available whenever one pushes a button, although we have to select necessary information from a mixture with unnecessary ones. We live in the era of images. Television affected our lives greatly. Weekly magazines of comics and pictures are more popular than those in which something to read are contained.

These situations have made young people feel that they have known everything they learn in schools. They cannot be serious because the knowledge which is to be acquired in schools seems to them obsolete, though they do not actually understand it. There are too many black boxes in daily life. Yet they do not feel the presence of the black boxes inconvenient. They are rather convenient in modern life. So students do not feel necessity of opening the black box. It is there and convenient without knowing inside. Logical thinking and reasoning are nuisance to them.

So far the present situation of science education in schools has been reviewed and some analyses have been made. I wish to make some comments now. It seems that the society is directing to that where no competition exists. However, the mankind has made progress by competing. Lacking competition may mean that the mankind is directing toward decline. We must warn public that unless we give a brake to the tide the society of human being will become unhealthy. Judgement is of absolute necessity even in daily life. From available information, we have to select necessary one. Otherwise, our judgement will be in error. If people lose the ability of judgement and act as some other people say, that may lead to revival of Nazism. Therefore, logical thinking and reasoning should be given top priority in pre-college education.

A possible solution to the above problems in Japan is to seek diversity in education departing from uniformity. Although

the national syllabus has a merit of up-grading the science level of Japanese people as a whole, it cannot meet the existing situation because of the variety of students and sophistication in science. Although there are people who dislike national syllabus, there are countries in the world which are feeling wrong of the absence of a national syllabus. Probably two or three courses in the national syllabus will do something good. For those who want to be scientists, they can take a course which may be similar to the exisitng one. This will be good for people who are seeking good successors. Those who wish to persue subjects other than science may take other courses of science in which logical thinking and reasoning rather than systematic science are emphasized. Here, people may not worry about too many items in the syllabus, yet they can foster the ability of judgement which is needed in the days to come.

Change in the system of teacher training should be given top priority. There have been various efforts and attempts to reform science education in the world. Most of them, if not all, have failed because teachers could not handle the new idea. In implementation of a new syllabus in education, able teachers are indispensable. And yet, all the teachers should be able to handle the new idea. Otherwise, opportunities for children might be uneven. Some device is necessary for fostering teachers especially for the courses which stress logical thinking and reasoning rather than the traditional system of science. Something has to be done and researches in this direction should be given priority.